

**Seasonal and interannual  
variability diagnosed from IASI  
spectra and comparison to  
simulations**

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Space & Atmospheric Physics

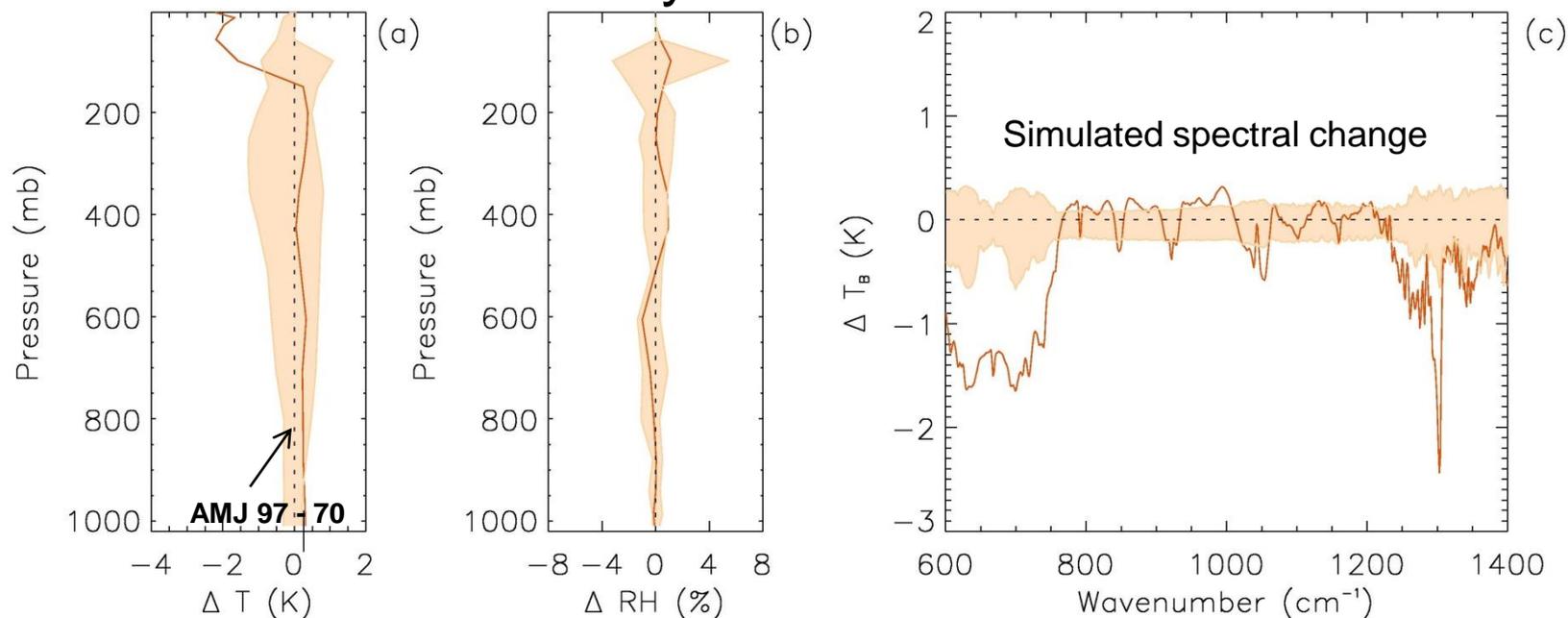
CLARREO Science Team Meeting, October 2011

# Outline

- Motivation
  - Previous work
  - Aims
- Current status
  - Observational data
  - Simulations
- Future activities
- News from the UK

# Motivation

- Previous efforts rely on model based estimates

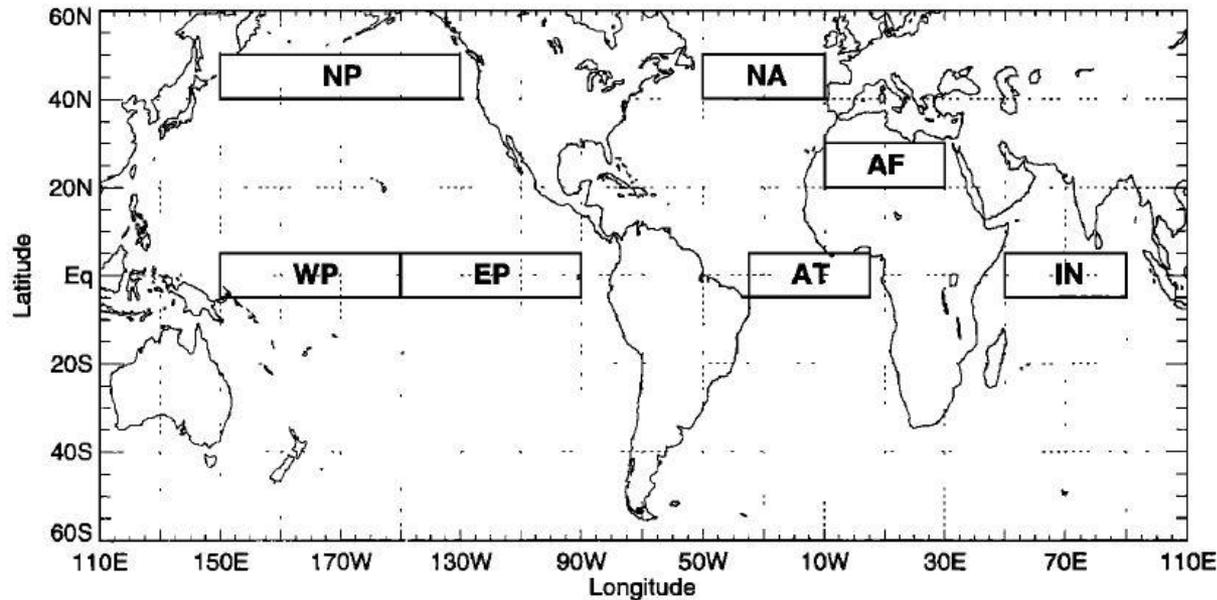


Brindley and Allan QJRMS 2003

- Better to use a COSP-style approach to simulate spectrally resolved radiances
- Interim solution

# Regional assessment of IR spectral variability

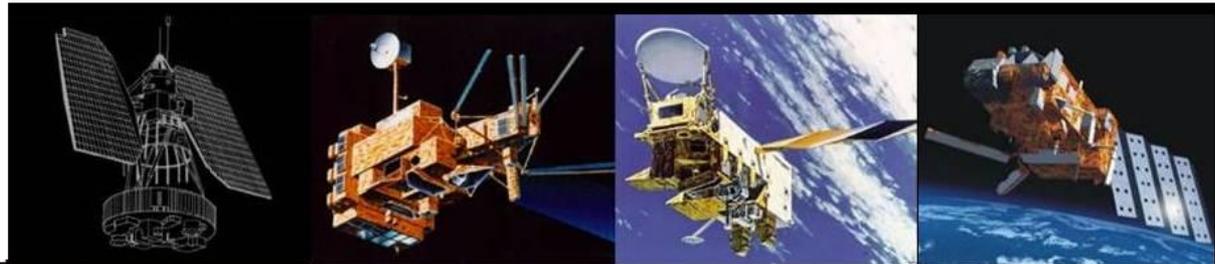
IACONO AND CLOUGH: SPECTRAL RADIANCE AND CLIMATE VARIABILITY



**Figure 3.** Geographic regions examined in this study. “WP” refers to western Pacific, “EP” to eastern Pacific, “AT” to Atlantic Ocean, “IN” to Indian Ocean, “AF” to Sahara Desert, “NP” to North Pacific, and “NA” to North Atlantic.

- Comparisons with previous studies using IRIS
- Prohibitive data volumes (~10TB/year IASI Level 1C) -> regional analysis

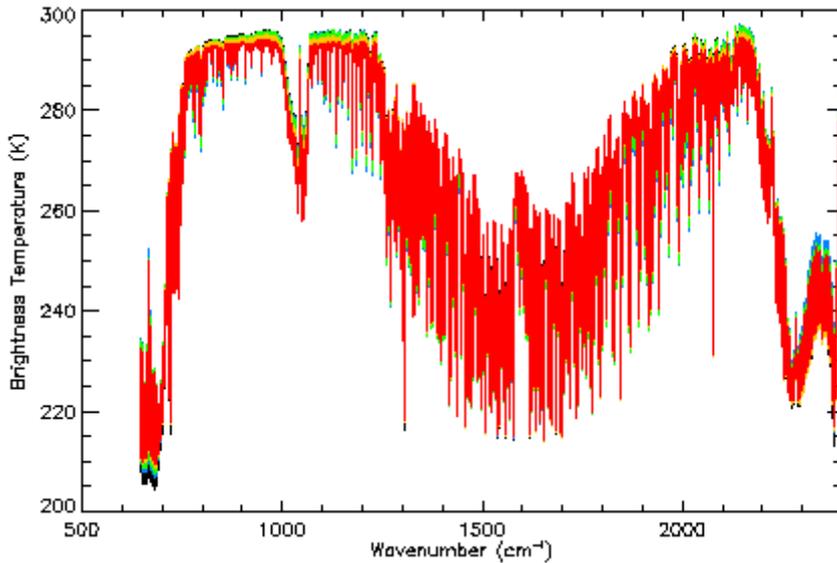
# Spectral signatures from satellite data at Imperial



Instrument	<b>IRIS</b>	<b>IMG</b>	<b>AIRS</b>	<b>IASI</b>
Satellite	Nimbus 4	ADEOS	AQUA	METOP-A
Spectro-meter type	FTS	FTS	grating spectrometer	FTS
Data available	Apr 1970 – Jan 1971	Oct 1996 – Jun 1997	2002 - present	2007 - present
Spectral coverage (cm <sup>-1</sup> )	400 – 1600 cm <sup>-1</sup> continuous	715 – 3030 cm <sup>-1</sup> 3 bands	650 – 2700 cm <sup>-1</sup> 2378 bands	645 – 2760 cm <sup>-1</sup> 3 bands
Spectral resolution	2.8 cm <sup>-1</sup>	0.1 cm <sup>-1</sup>	0.4–1.0 cm <sup>-1</sup>	0.5 cm <sup>-1</sup>
Footprint (nadir)	95 km diameter	8km x 8km	13 km diameter	12 km diameter

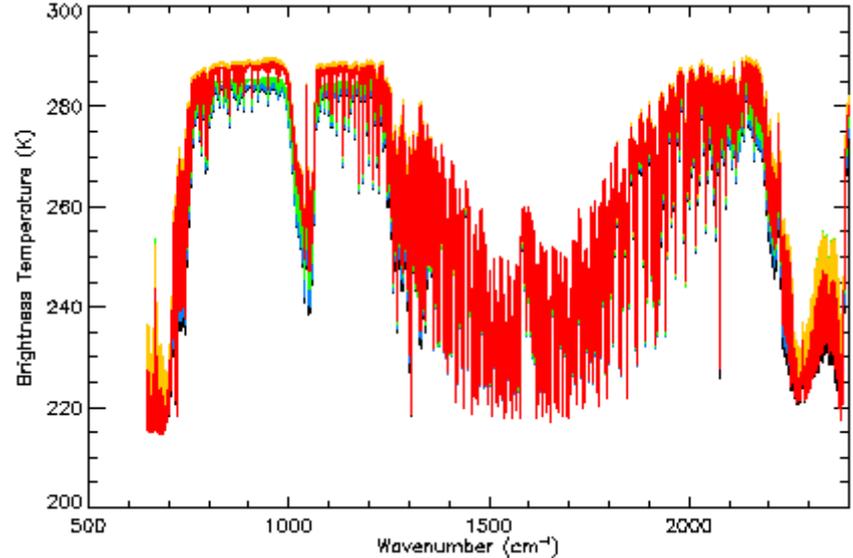
# IASI – Seasonal mean clear sky spectra

— DJF    — MAM    — AMJ    — JJA    — SON



## East Pacific, 2010

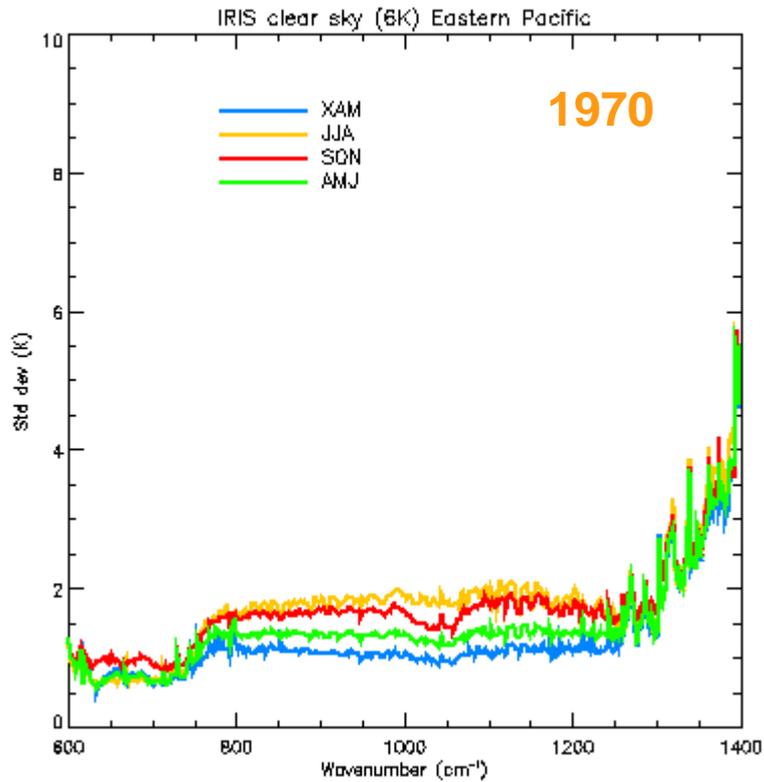
DJF: 7968 (26 %)	299.644K
MAM: 10354 (42 %)	300.527K
JJA: 9465 (28 %)	297.980K
SON: 8703 (27 %)	296.706K



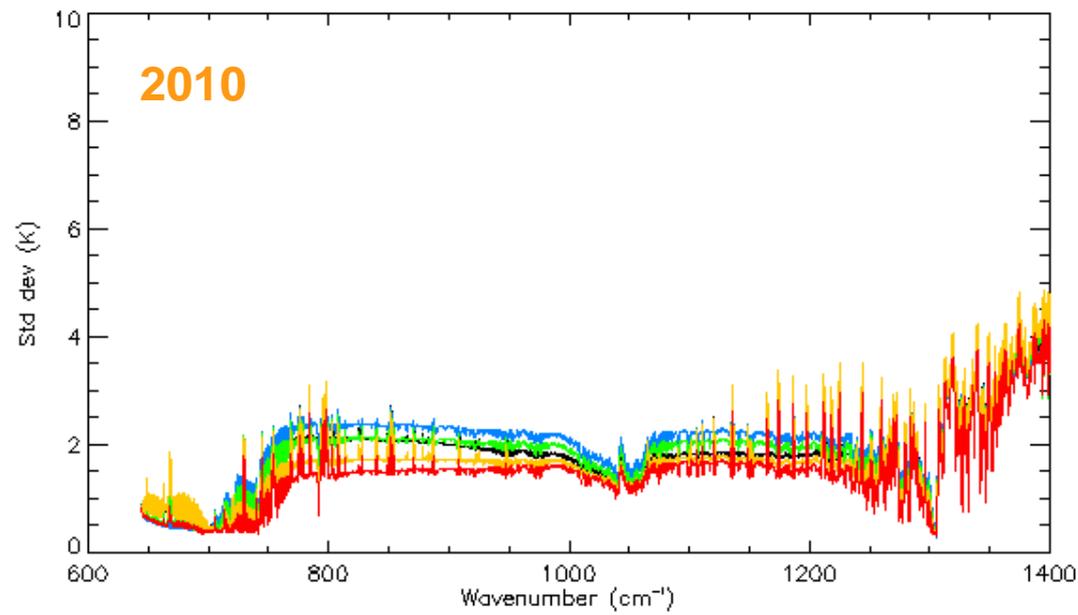
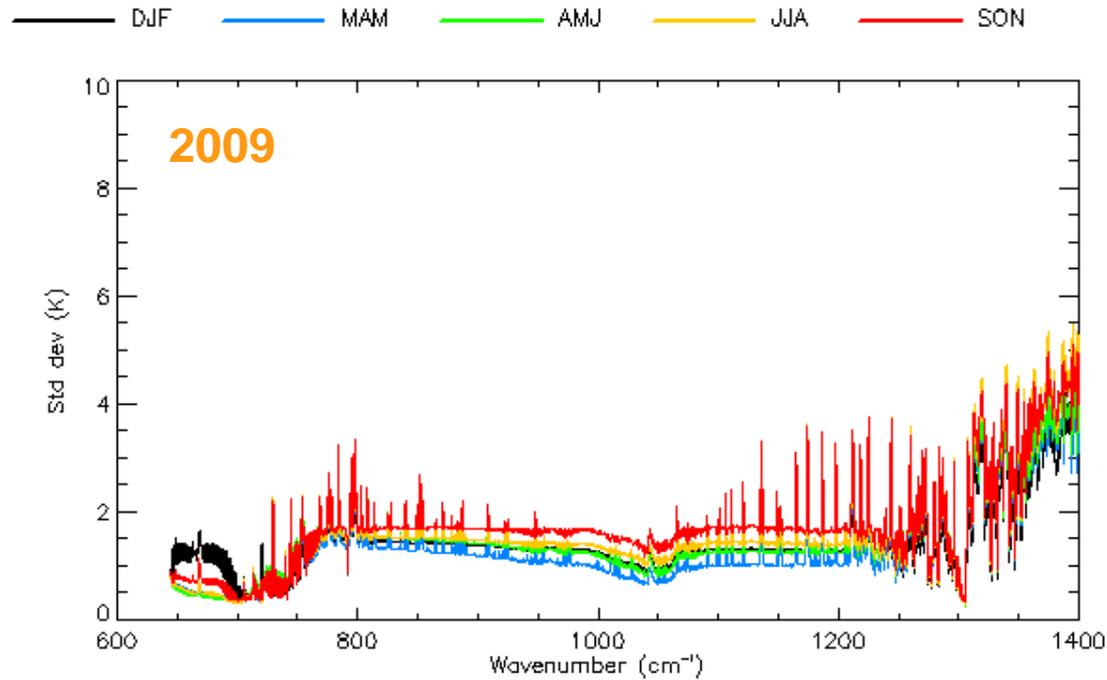
## N. Atlantic, 2010

DJF: 1295 (8 %)	284.948K
MAM: 2740 (13 %)	285.683K
JJA: 2925 (15 %)	291.050K
SON: 1783 (9 %)	290.392K

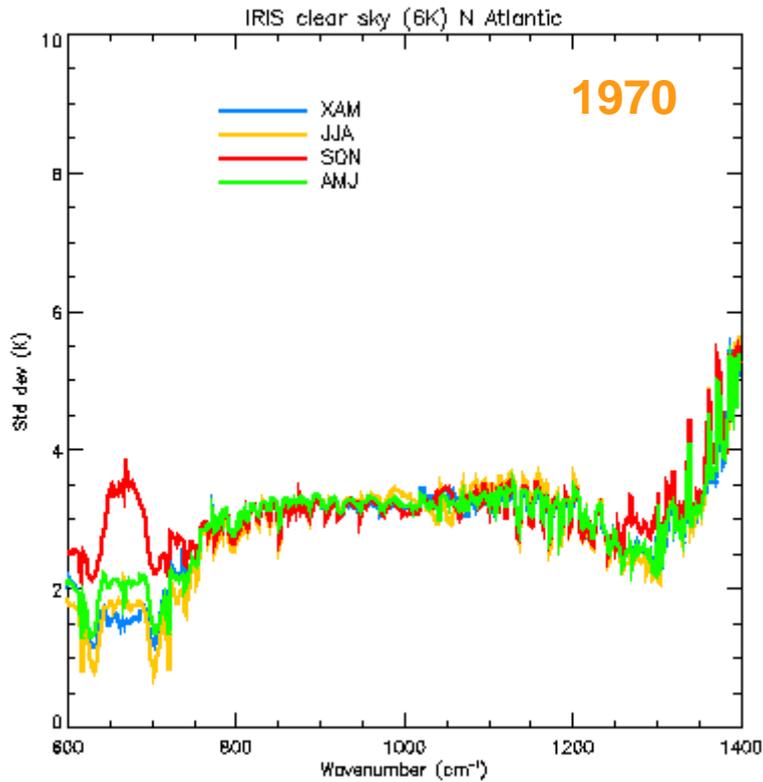
# 1970, 2009, 2010



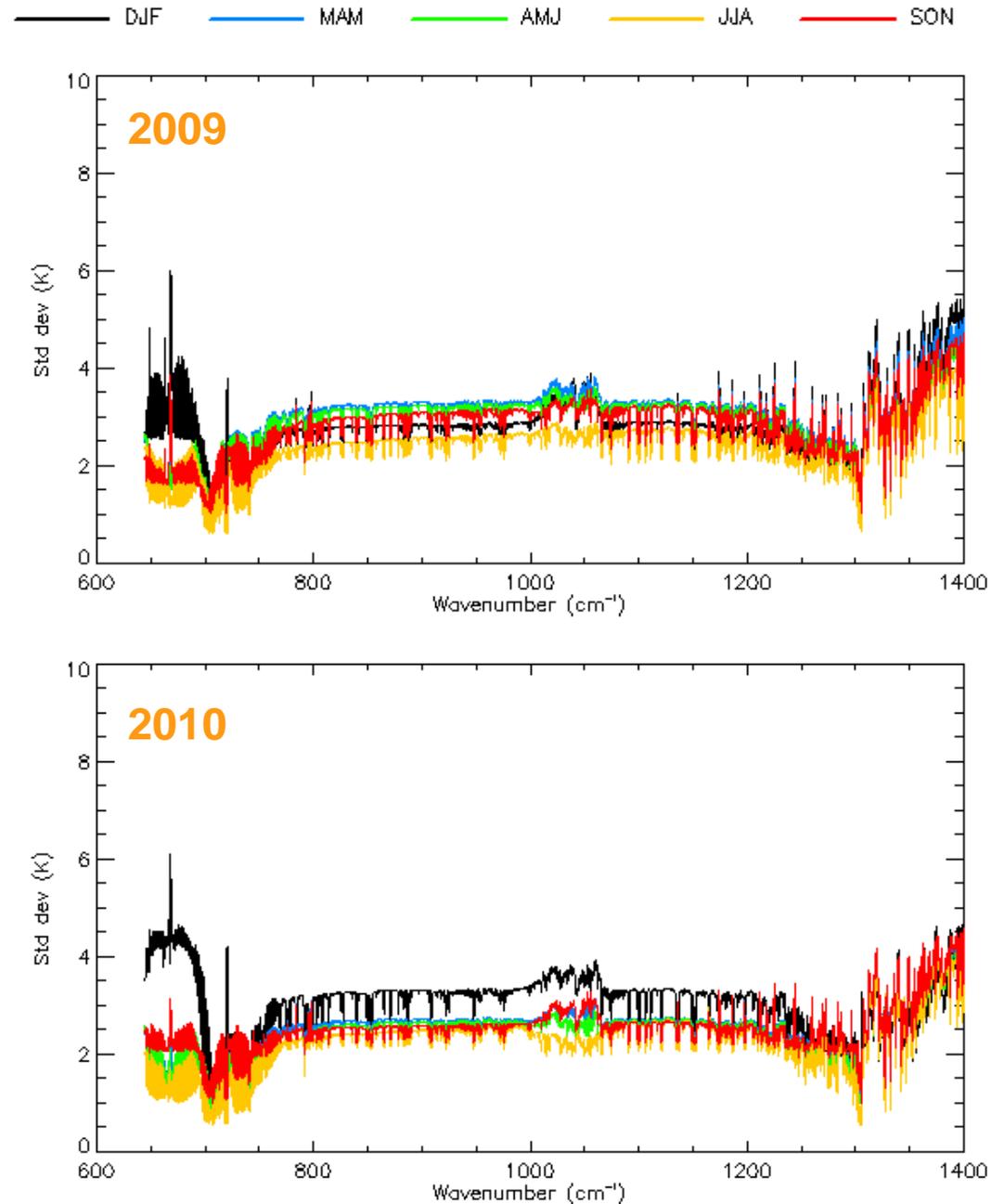
Eastern Pacific



# 1970, 2009, 2010

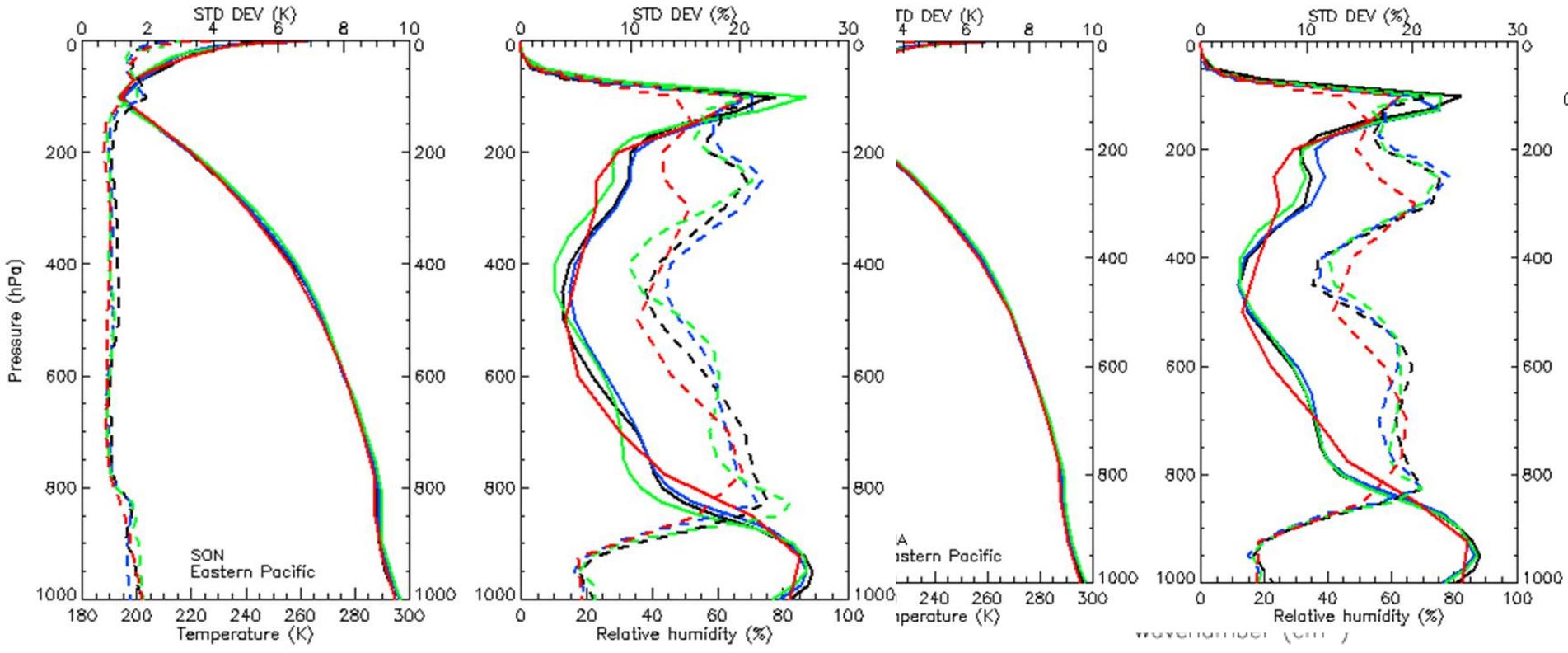
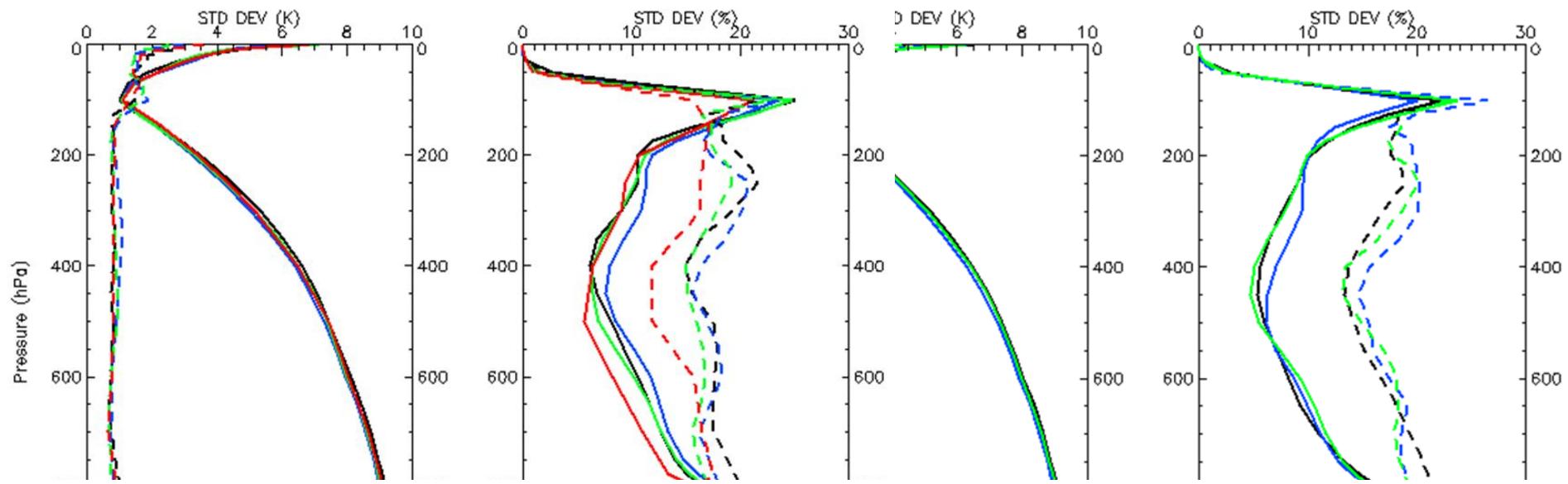


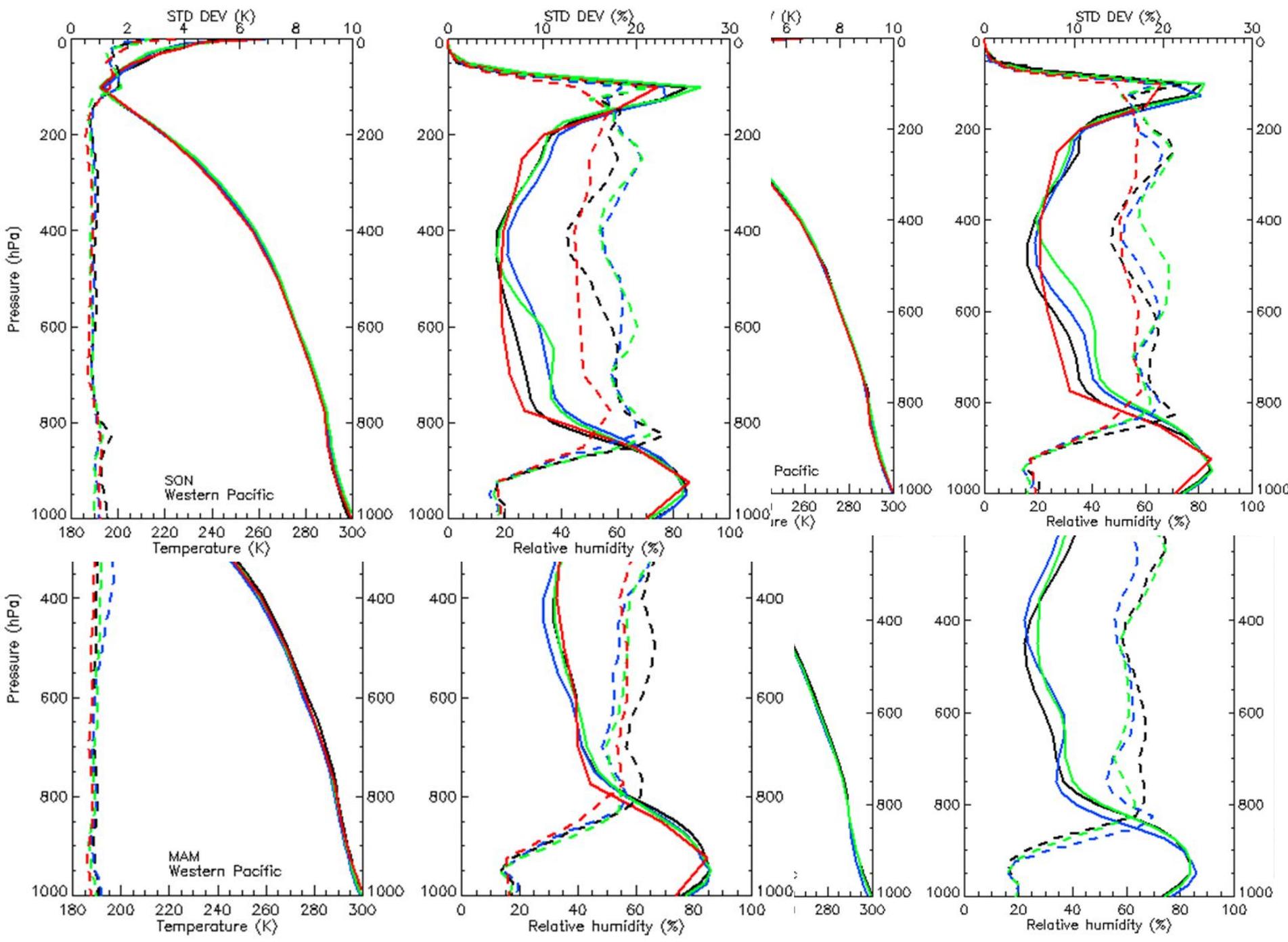
North Atlantic



## IASI – clear sky seasonal variability

Q: IASI clear sky variability compared with ERA-I profiles of T and H<sub>2</sub>O – are they consistent?





# Towards generating a spectrally resolved database from ERA: Modelled 'clear-sky' variability from ERA Interim

- ERA Interim covers period 1989\* onward
- Profiles of T, H<sub>2</sub>O<sub>(g)</sub>, O<sub>3</sub> from reanalyses (now using 6-hourly)
- CO<sub>2</sub>, CH<sub>4</sub>, N<sub>2</sub>O from UKMO records (total column, 5 year global mean, interpolation)
- Surface emissivity constant at 0.99 globally
- Spectral radiances simulated at nadir using Oxford RFM (HITRAN 2008)

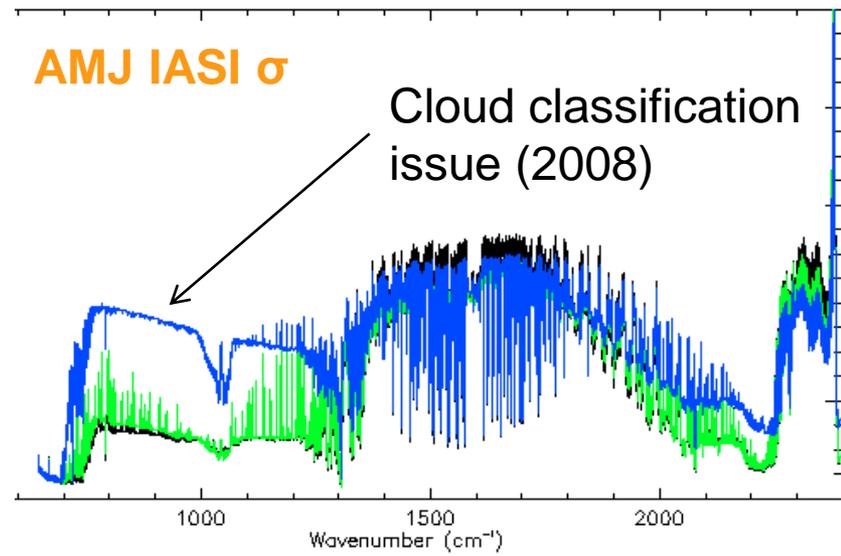
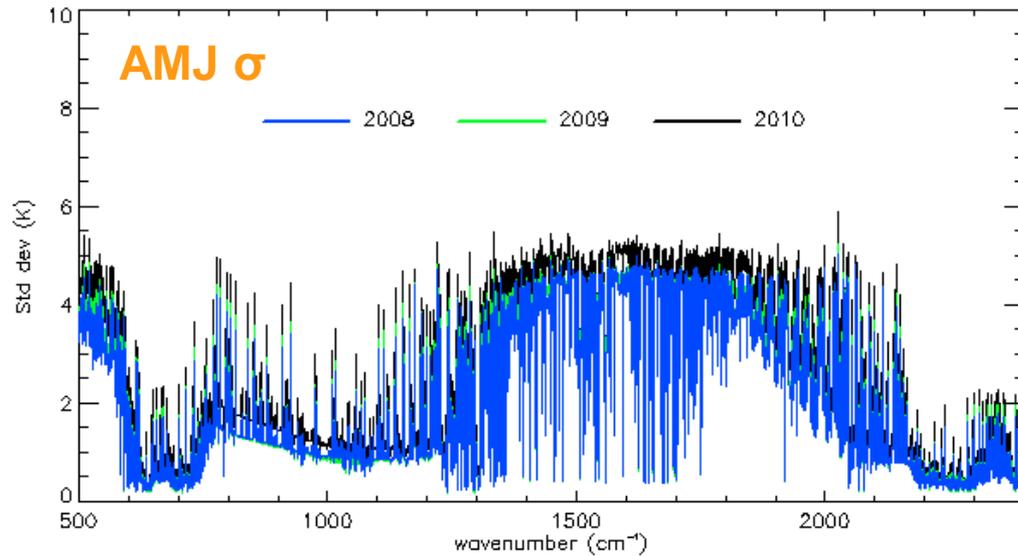
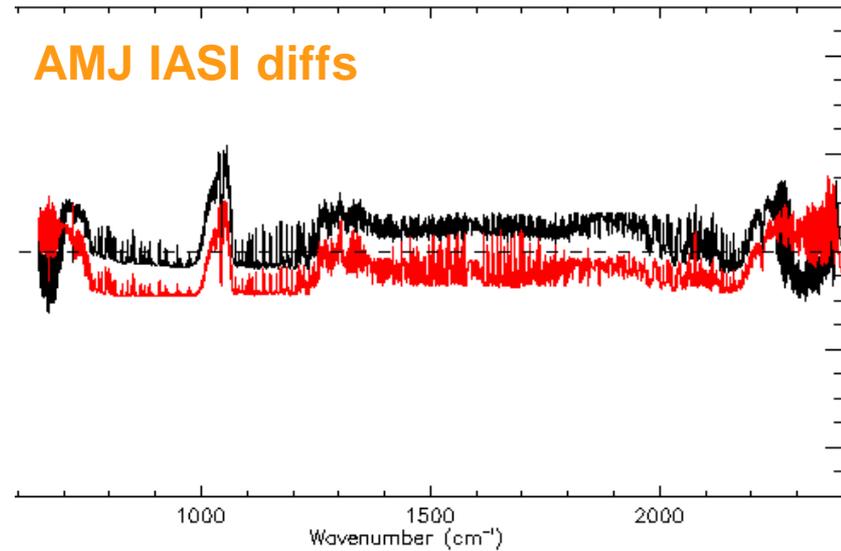
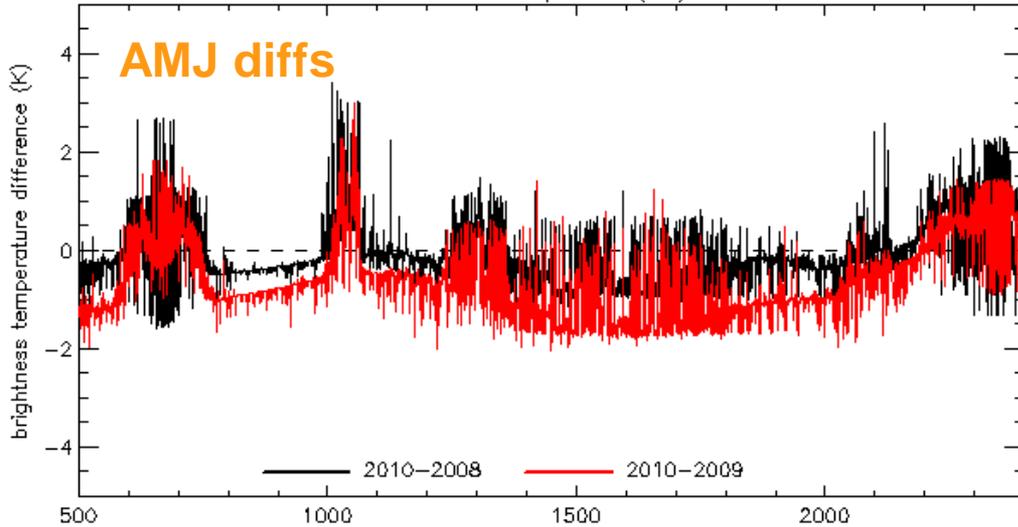
\* 1979 planned

# Previous RFM model runs

- So far: 1989, 1994, 1999, 2004-2010
- monthly mean fields ('clear-sky' but using all profiles)
- Now using 6-hourly profile data – clear sky only (identified using ERA-I cloud information)
- 37 atmospheric levels (1000-1mb)
- spatially resolved  $1.5^{\circ} \times 1.5^{\circ}$
- $100\text{-}2500\text{cm}^{-1}$ , spectral resolution  $0.5\text{cm}^{-1}$

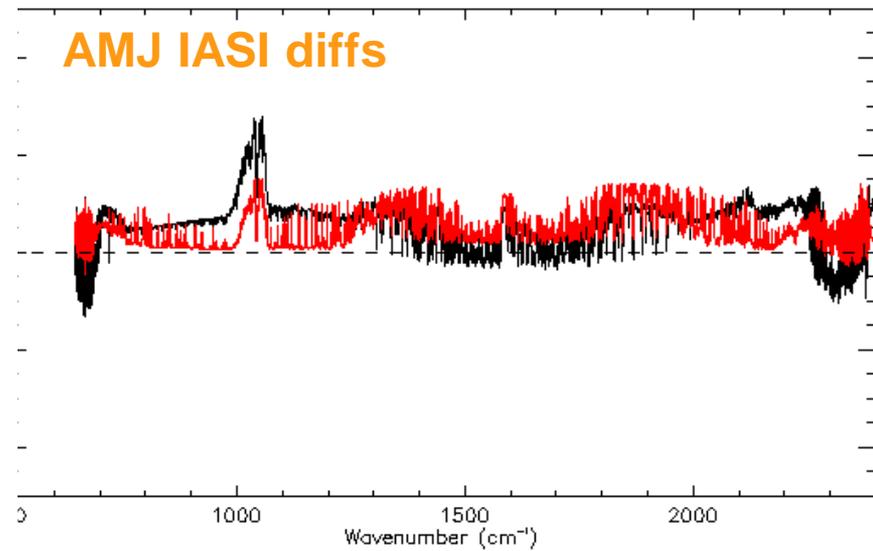
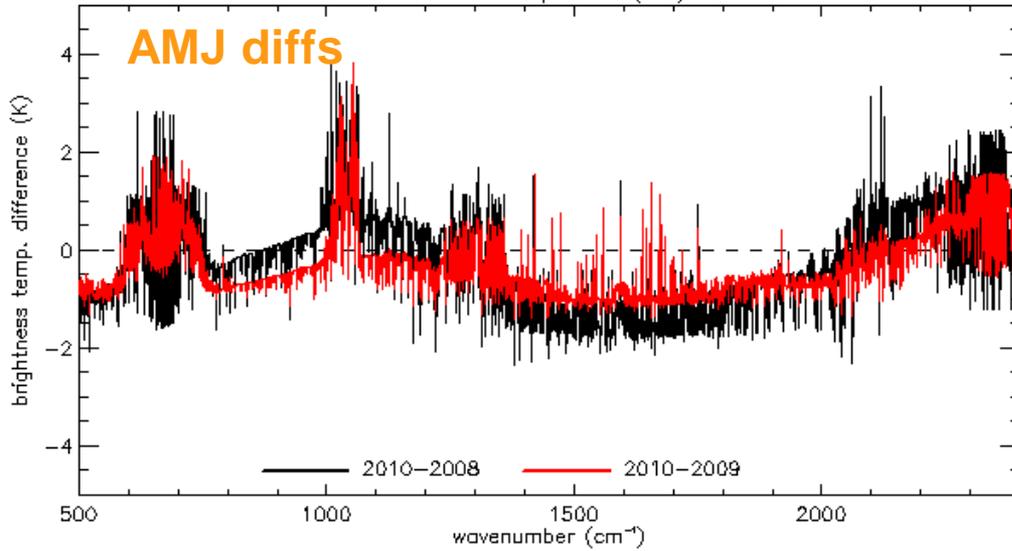
# Simulated spectra vs observations (EP)

Modelled spectra (EP)

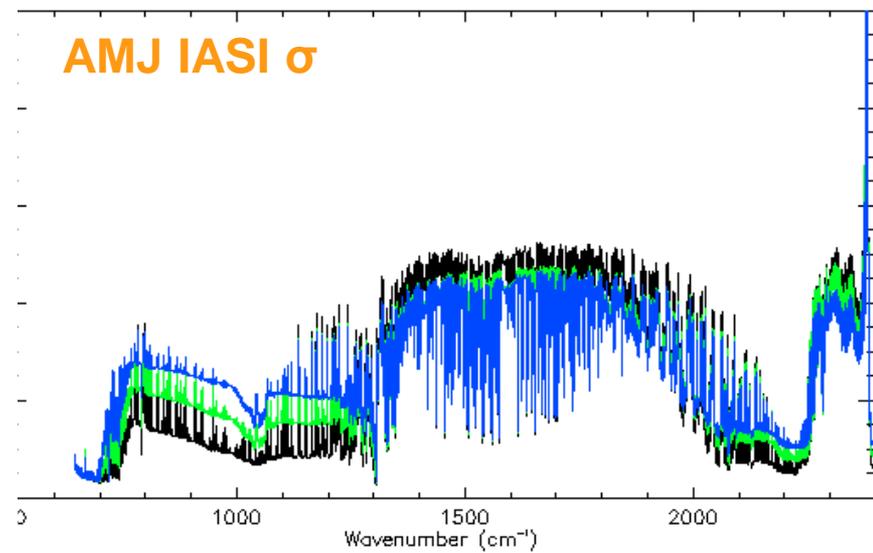
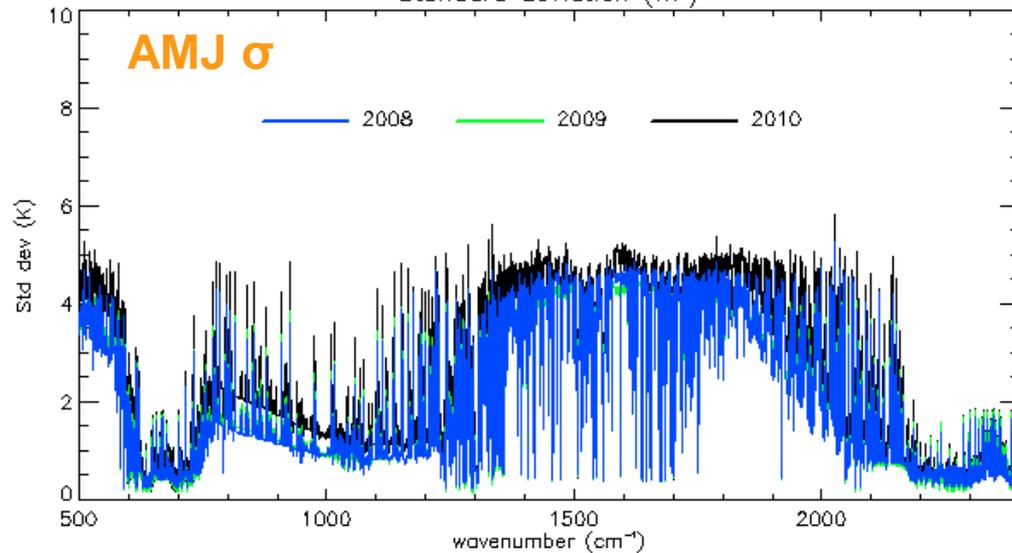


# Simulated spectra vs observations (WP)

Modelled spectra (WP)



Standard deviation (WP)



## Summary / future activities

- Extension of previous work using monthly mean ERA-I profiles (focus here: clear sky and 6-hourly resolution)
- Intend to extend simulation vs observations (regions, increased record length, clouds / all-sky)
- Limited UK funding for continued support for CLARREO-related studies but interest at UKMO for COSP-style IASI/CLARREO comparison

# ESA - AO for ISS experiments relevant to the study of climate change

- Emission Fingerprints of Tropical Water Vapour and Clouds (EFTWVC)
- Lead – Luca Palchetti (CNR Italy)
- Letter of intent submitted Sept 11
- Partners include Imperial, LaRC, ..
- Based on REFIR (FORUM)

# UK Space Agency – Earth Observation Programme

- Round table discussion on developing business case for UKSA EO Programme (UKSA, NERC, NCEO, CEOI)
- Strong emphasis on support for development of bilateral programmes for technology and mission development
- CEOI to provide £50K for “sandbox study” to demonstrate the TRUTHS concept
  - 2 day workshop to: clarify mission objectives, assess complementarity to CLARREO, and identify focus for technical part of the study
  - 6 week technical study
  - Participation from CLARREO team welcomed